

In the twenty headings under which the agencies which influence human life were arranged, the ancient seers believed they had exhausted the arithmetical unit which stood for the completed individual—his vigesimal equation and correlate; in the thirteen modes of activity which they assigned to each of these agencies, they had taken into account the thirteen possible relations of each to both the material and immaterial worlds; and the fact that the result of 20×13 expressed in days gives approximately nine lunar months, the period required for the unborn babe to pass through its evolution from conception to birth—a period perfectly familiar even to the wild hunting tribes—gave them whatever needed confirmation they wished for the mystic potencies of these cardinal numbers.

The Great Mesozoic Fault in New Jersey.

By Benjamin Smith Lyman.

(Read before the American Philosophical Society, September 15, 1893.)

Great faults, the ever-ready, easy resource of geologists to cover up their own deficiencies or mistakes, have, without any substantial proof, been liberally conjectured again and again to account for what has been supposed to be a wholly impossible apparent thickness of the older Mesozoic rocks of New Jersey. For those rocks have, from their conformability throughout, and their predominant color and a comparative lack of fossils through a great part of them, been commonly lumped together as only a single group, formation, or system, under the general name of New Red, or Triassic, or Jurassico-Triassic, or Rhaetic. Nearly forty years ago, with the bold assurance born of ignorance, perhaps quite pardonable at that time, the special name of Newark group was proposed for the whole lot, from one of its most striking local economic features, though otherwise an extremely subordinate one, and even economically perhaps inferior to the Richmond coal; and latterly there has been an effort to revive the name, long after it had fallen into well-merited oblivion. The assumption has been: the whole series is but one formation; one formation can be no more than about 5000 feet thick; therefore, the whole series is at most 5000 feet thick.

It now appears, however, from recent researches in course of publication by the Geological Survey of Pennsylvania, that the total thickness of the so called New Red does incontestably far exceed the thickness

usually given to any single formation ; but, on the other hand, that there is no sufficient reason yet to believe that all the rocks do belong to one paleontological group or formation. The comparatively few fossils found have hitherto been ascribed indiscriminately to the whole so-called formation, without any exact knowledge of the relations of beds of different localities to one another. Perhaps too great reliance has been placed in the capacity of fossils to indicate the geology of a vast series of beds in great measure devoid of them ; and the more laborious, purely geological methods of combining numerous observations of dip, strike and elevation, with the help of topographical indications, have long been neglected, because there was likely to be no sufficient immediate economic return.

At length, however, the series has been practically worked out by proceeding throughout from one exposure to another near it ; instead of simply assuming a nearly constant dip in one northwesterly direction and estimating the consequent total thickness from the whole breadth of the region filled by the beds. It has now become possible to ascertain from what part of the series the different fossils of the region have come, at least in Eastern Pennsylvania ; and it is seen that nearly all of them have in reality been taken from one small portion, although they have been supposed to indicate the age of beds many thousands of feet above or below. It is also seen that the geological structure is not so extremely simple as it was formerly supposed to be ; and that no set of straight parallel faults could have diminished to the desired extent the apparent thickness of the series of beds in Eastern Pennsylvania, for the beds curve strongly and extensively in many directions.

It has, however, long been known that, in the midst of the New Red there, an island, so to speak, of ancient Paleozoic rocks occurs. It was never certainly known, to be sure, whether it was really an island in the New Red sea, with New Red beds of equal age north and south of it ; or had later been thrust up through the New Red beds (or remained fixed while the New Red beds on the south sank down), so as to occasion a great disparity in the age of the beds of the two sides. Now it is positively known that there is such a great difference, and that the New Red beds to the south are several thousand feet higher in the series than those on the north. The line of the southern edge of the ancient island continues westward as a great fault ; but far from parallel to the strike, and consequently not helping much, if at all, to diminish the great apparent thickness of the New Red. The fault is there the more obvious from a marked difference in the color of the rocks on its two sides.

But at the eastern end of the island of ancient rocks, just in the edge of New Jersey, the circumstances are somewhat different. There the strike of the beds on the northwest and on the southeast is nearly the same ; and, moreover, the beds of both sides are mainly red ; and they are, besides, in general rather soft shales. Consequently, without the proof given by the observations in Pennsylvania, or perhaps by some not yet made in other parts of New Jersey, it would be extremely difficult, if

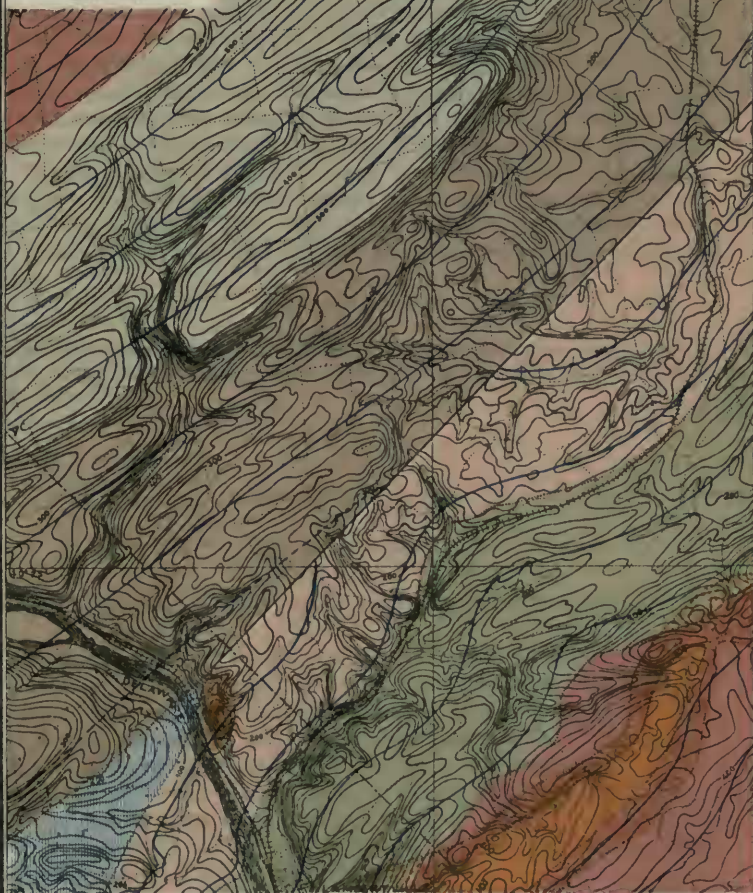
not wholly impossible, to detect, still more so to prove, the existence of the fault, in spite of its great throw of over fourteen thousand feet.

The accompanying sketch map shows, at least roughly, the prolongation of the fault nine miles northeastward into New Jersey and of equidistant strike curves, a thousand feet apart in level, on the bottom of different sets of Mesozoic shales north and south of the island-like mass of Paleozoic limestone, of Pennsylvania formation No. II, from the positions determined west of the Delaware by the recent survey. It has been possible to make, roughly, the prolongation of the lines without observing any rock exposures in New Jersey; because the topography shows the geological structure very distinctly on the north of the fault, and with some clearness on the south. On the north, the long straight hills and valleys show very plainly that the strike of the rocks continues almost straight northeasterly in the same general course as on the Pennsylvania side of the Delaware, and nearly parallel to the fault, but gradually bending more to the north. South of the fault the strike as shown by the topography, though not very far from parallel to the fault, is evidently decidedly less straight in the western edge of New Jersey, as it is also in Pennsylvania; but farther east becomes for a space straighter and more closely parallel to the fault and to the northern strike. This structure of the southern shales is confirmed by the topography outside the limits of the map.

The shales on the north of the limestone and fault belong to the same set of beds, mostly soft shales as those near Norristown, and near Yardleyville; while those next south of the limestone and fault are of the set of likewise red, mostly soft shales that is seen near Pottstown, overlying the couple of thousand feet of generally harder and in good part greenish shales of the Perkasié tunnel and its neighborhood, that themselves rest on the red shales of Lansdale. The trap masses given are copied from the New Jersey State geological map, except that the limits of solid trap in place have been conjecturally restricted, according to our experience in Pennsylvania, to only a portion of the whole space covered by blocks of trap and its decomposed earth.

It is very interesting to see how clearly the mere topography shows the geological structure, and so in conjunction with the ascertained relations of the beds north and south of the limestone, makes the presence of the great fault in New Jersey to be known with certainty, in spite of its otherwise thorough concealment through the similarity of the northern and southern shales and of their strikes. The topography, indeed, gives good indication of the geological structure far beyond the limits of the little map, and would perhaps do so through all the New Jersey portion of the older Mesozoic, in spite of the less pronounced variation in character of its beds as regards hardness than what we find among Paleozoic rocks. Now that the older Mesozoic series of beds has been so fully worked out in Eastern Pennsylvania, with several subdivisions of such different color and texture as to be very noticeable in traversing country

SKETCH MAP
OF PART OF THE
GREAT FAULT
IN THE
NEW JERSEY MESOZOIC.
BY
BENJAMIN SMITH LYMAN
SEPT., 1893.



THE TOPOGRAPHY IS FROM THE MAPS OF THE N. JERSEY AND U. S. GEOLOGICAL SURVEYS, WITH 20-FT. CONTOUR LINES. THE MAKE OF THE FAULT AND THE EXTENT OF THE TRAP BEDS ARE UNKNOWN.

TRAP RUSSISH. POTTSTOWN SHALES. LANDSALE SHALES. NORRISTOWN SHALES.
TRAP IN PLACE. PERKASIE SHALES. GWYNEDD SHALES. PA. NO. II LIMESTONE.

SCALE:- 2 MILES TO AN INCH, OR 1 : 126 720.

0 1 2 3 4 5 6 7
MILES

SECTION IN THE LINE A B.

A

B

